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The e-business readiness composite indicator for 2003: a pilot study

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Executive Summary

The Council Resolution of 28 January 2003[1] on the implementation of the eEurope 2005 Action Plan (5197/03) requested Eurostat to carry out a pilot exercise to calculate a composite indicator on e-business readiness, using data from the enterprise survey conducted in 2003. The components of the e-business readiness composite indicator were listed in the Annex 2.H of that Council Resolution and were grouped by Council into two broad classes of 'Adoption' and 'Use' of ICT technologies.

Eurostat and the Joint Research Centre of the European Commission have jointly implemented the pilot exercise. This report presents the main issues and conclusions of the pilot exercise, based on the analyses performed and on meetings held with experts from the Commission Services (DG ENTR, DG INFSO and DG ESTAT), academia (University of Tuebingen, D; University of Bologna, I, Bocconi University, I) international organisations and national statistical offices held in Ispra (expert group meeting, 29 September, 2003), Luxembourg (ISS Working Group meeting 14-15 October, 2003) and Paris (Steering group meeting of the e-business support network, 28 October, 2003).

This document is organised as follows: an introductory section presents the general framework and the main steps required for the specification of a composite indicator. In the second part, these issues are analysed in the light of the observed data, collected by Eurostat in 2003. The final part draws the conclusions and presents some proposals for the continuation of the exercise.

It is important to underline a relevant drawback for the exercise: on May 1st 2004, not all Member States had provided the data sets as requested[2], and therefore the outcome of the exercise can be considered neither exhaustive nor definitive.

The result of the pilot exercise indicates the feasibility of building a composite indicator on e-business readiness. However, both the statistical analysis and the inspection of the component indicators denote a partial overlapping of the category Adoption and Use. Furthermore, the index is limited by the lack of important dimensions in the Adoption of ICT (market conditions and infrastructure, legal framework, regulation) and the absence, in the category Use of ICT, of internet connection costs (one of the major

[1] http://www.eseeurope.undp.ba/sadrzaj/RelatedDocuments/sadrzaj/terms/Indicators%20Resolution.pdf

[2] Full data set missing for Greece; France: only six indicators available; these Member States could not be included in the pilot exercise. Data sets incomplete for Germany and UK, as indicated in table 2.

factors determining the use of ICT) and supporting services. The reallocation of some component variables to be more consistently "use" or "adoption" is also suggested. The human capital dimension could also be mapped better. The report discusses the necessity for the critical revision of the index and proposes possibilities for improvements. A special effort has been made for assessing the impact of various solutions on the final ranking of countries. If a composite indicator on e-business readiness is judged politically important, a dynamic review of the selection of the basic indicators and their aggregation would appear advisable.

1. *Introduction*

The eEurope 2005 Action Plan (COM(2002) 263 final)[3], endorsed by the Council Resolution of 28 January 2003 (5197/03) calls for a benchmarking of the target that 'by 2005, Europe should have […] a dynamic e-business environment', specifying that 'e-business comprises both e-commerce (buying and selling on-line) and restructuring of business processes to make best use of digital technologies'. It proposes general guidelines for the benchmarking exercise and sets out a number of indicators to monitor progress in the implementation of the eEurope 2005 Action Plan.

The indicator chosen to monitor e-business readiness is a composite indicator called 'e-business index'. It is composed of twelve basic indicators, grouped into two aggregates: '*Adoption of ICT by business'* and *'Use of ICT by business'*, as listed in *Table 1*.

Table 1. List of sub-indicators for the composite indicator on e-business readiness

Indicator	Description
Adoption of ICT by business	
a1	Percentage of enterprises that use Internet
a2	Percentage of enterprises that have a web site/home page
a3	Percentage of enterprises that use at least two security facilities at the time of the survey
a4	Percentage of total number of persons employed using computers in their normal work routine (at least once a week)
a5	Percentage of enterprises having a broadband connection to the Internet
a6	Percentage of enterprises with a LAN and using an Intranet or Extranet

[3] http://europa.eu.int/information_society/eeurope/news_library/documents/eeurope2005/eeurope2005_en.pdf

Use of ICT by business

b1	Percentage of enterprises that have purchased products / services' via the internet, EDI[4] or any other computer mediated network where these are >1% of total purchases
b2	Percentage of enterprises that have received orders via the internet, EDI or any other computer mediated network where these are >1% of total turnover
b3	Percentage of enterprises whose IT systems for managing orders or purchases are linked automatically with other internal IT systems
b4	Percentage enterprises whose IT systems are linked automatically to IT systems of suppliers or customers outside their enterprise group
b5	Percentage of enterprises with Internet access using the internet for banking and financial services
b6	Percentage of enterprises that have sold products to other enterprises via a presence on specialised internet market places

A composite indicator is obtained as a "combination" of several basic indicators. Such a combination is generally restricted to an aggregation (using a standard operation like an additive or a multiplicative one) of weighted basic components.

The steps generally required for the definition of a composite indicator are the following:

1. Clear definition of the phenomenon under study and of the objectives of the composite indicator. On the basis of this, selection of the basic indicators to include in the composite indicator.
2. Univariate analysis of the available basic indicators, with special emphasis on the missing observations. The treatment of missing values should be dealt with at this stage as well.
3. Choice of an appropriate standardization method for the component indicator. If the single components are expressed in different units, reveal great variation with respect to the mean, or are of different magnitude, it is important to make the data comparable before aggregating them.
4. Multivariate analysis of the basic indicators: analysis of the correlation table, with special emphasis on high values. A principal component analysis can help exploring the structure of the data set.
5. Choice of the aggregation formula, i.e. the mathematical operation used for combining the basic indicators. The most widespread practice is that of adding up the basic indicators. For certain phenomena the analyst can assume, on the

[4] Electronic Data Interchange

basis of the outcome of step 1, that a multiplicative aggregation is the most appropriate.

6. Choice of the weights assigned to each basic indicator. In order to reflect the relative importance of the single basic indicators and to avoid duplication of counting, weights can be assigned to the basic indicators. Many methodologies can be applied here, none of them being *a priori* the best one: e.g. uniform weighting; weights taking into account the correlation structure of the basic indicators; weights defined according to a factor analysis; weights decided by experts through a budget allocation exercise. The weighting scheme might heavily influence the composite indicator.
7. Calculation of the composite indicator on the basis of the previous steps. Analysis of the results, checking the coherence with the framework model defined in the first step.
8. Test of robustness of the composite indicator with respect to:
   - the inclusion/exclusion of one (or more) basic indicator (step 1);
   - the treatment of missing observations (step 2);
   - the standardization method (step 4);
   - the functional form (step 5);
   - the weighting scheme (step 6).

   Should one of the robustness tests fail, the corresponding step should be revised, and a decision should be taken on whether the composite indicator is to be calculated again. Tests should be repeated until no new problem emerges.
9. Final assessment of the indicator, based on quality checks, and definition of a dissemination strategy.

It is fundamental that all of these activities are performed jointly by statisticians and experts of the phenomenon under study: this is a guarantee for the outcome to be sensible and useful.

In the following section, we apply the above mentioned steps to a composite indicator on e-business readiness.

2. Construction of the e-business composite indicator

The e-business composite indicator presented in this document is based on data collected in 2003 and reported in *Table 2*. The dataset has been completed by imputing the four missing values (shaded in the table), the missing countries have however not

been imputed. In the following, we apply to this data set the steps methodology outlined in section 1.

Table 2. Data set for the construction of the e-business readiness indicator

	EU	BE	DK	DE	ES	IE	IT	LU	NL	AT	PT	FI	SE	UK	IS	NO
Adp																
a1	86%	91%	97%	95%	82%	86%	83%	85%	86%	89%	70%	97%	95%	80%	97%	88%
a2	54%	62%	75%	71%	33%	59%	47%	58%	61%	66%	25%	70%	80%	63%	68%	63%
a3	56%	61%	81%	*64%*	31%	36%	61%	71%	71%	73%	49%	83%	87%	*79%*	81%	77%
a4	51%	59%	64%	44%	44%	46%	43%	57%	55%	50%	32%	66%	64%	*50%*	54%	57%
a5	40%	49%	69%	42%	51%	19%	31%	39%	37%	48%	31%	65%	62%	29%	20%	47%
a6	22%	38%	31%	22%	26%	26%	17%	30%	38%	27%	14%	33%	38%	23%	30%	24%
Use																
b1	13%	22%	23%	11%	3%	24%	4%	17%	20%	21%	9%	16%	23%	27%	15%	21%
b2	10%	20%	18%	9%	2%	14%	3%	13%	17%	12%	3%	18%	13%	20%	12%	13%
b3	24%	46%	35%	*19%*	36%	32%	12%	40%	60%	34%	21%	63%	23%	10%	31%	31%
b4	9%	12%	12%	*10%*	8%	17%	7%	15%	17%	13%	14%	17%	6%	6%	9%	10%
b5	61%	69%	79%	66%	67%	60%	48%	49%	70%	70%	53%	82%	77%	*51%*	92%	67%
b6	1%	2%	2%	1%	0%	1%	0%	1%	4%	1%	1%	3%	3%	*4%*	1%	2%

Source: Eurostat, Community survey on ICT usage and e-commerce in enterprises, 2003.

2.1. Selection of basic indicators

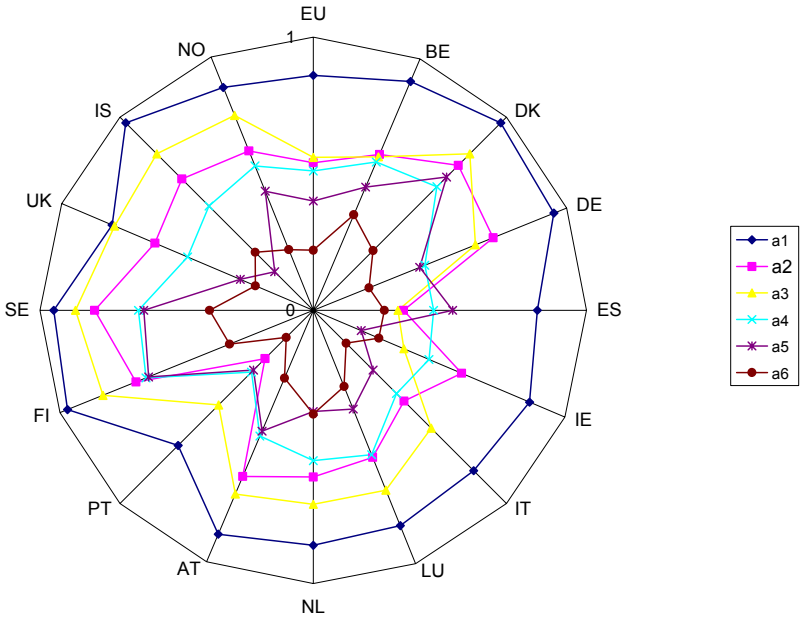
The 12 basic indicators used for the composite indicator were agreed by the Council. They were grouped into two groups "Adoption of ICT" and "Use of ICT", as detailed in Table 1. The country-based values are given in Table 2.

The statistical analysis that follows shows that the current set of indicators is in some cases highly correlated both within and between groups.

2.2. Univariate analysis of basic indicators

Data are totally missing for France and Greece, and incomplete for Germany and UK. The missing values for these two countries have been imputed (see the cells with grey background in Table 2). Radar plots for the two groups "Adoption of ICT" and "Use of ICT" are displayed in Figure 1a. Radar charts are useful to look at several different factors all related to one item. Radar charts have multiple axes along which all the variables can be plotted. Each variable is normalised between 0 and 1. A point close to the centre on any axes indicates a low value. A point near the edge is a high value. The graphs for each component indicator are given in Figure 1b.

Figure 1a. Radar charts for Adoption and Use of ICT, 2003 data



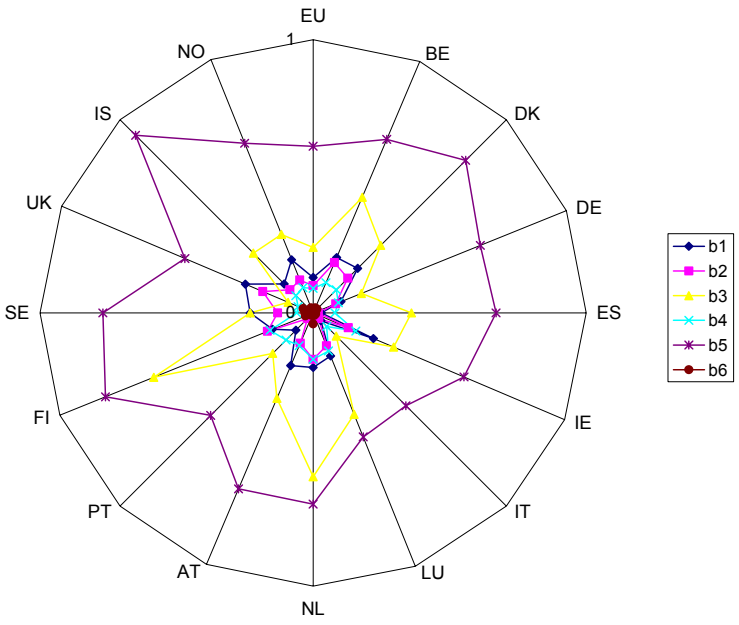

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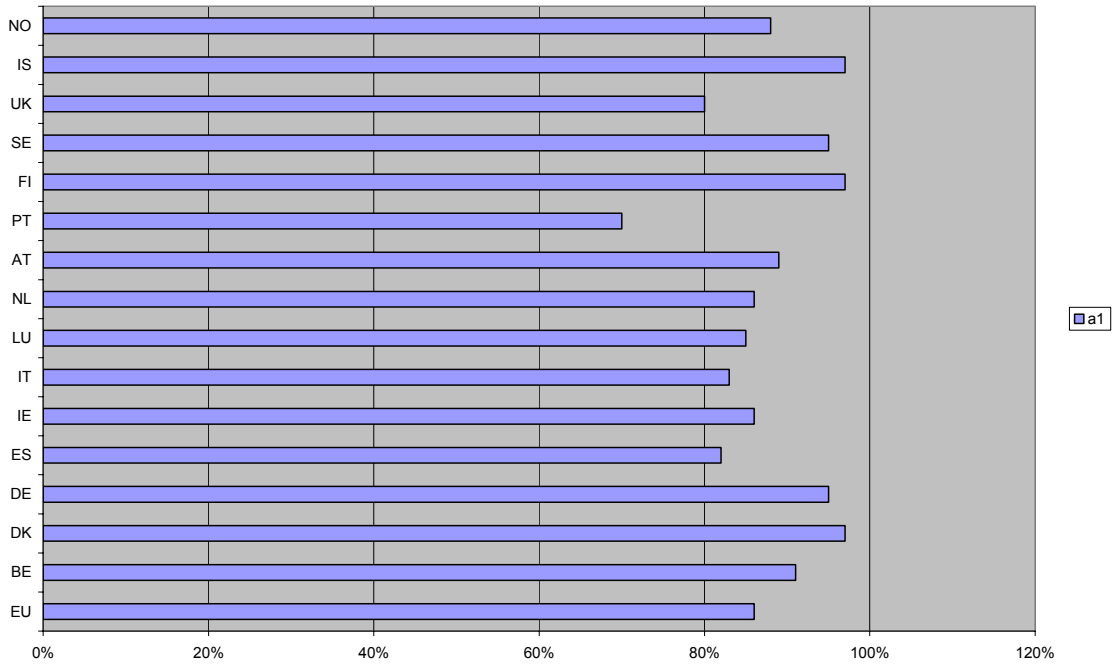
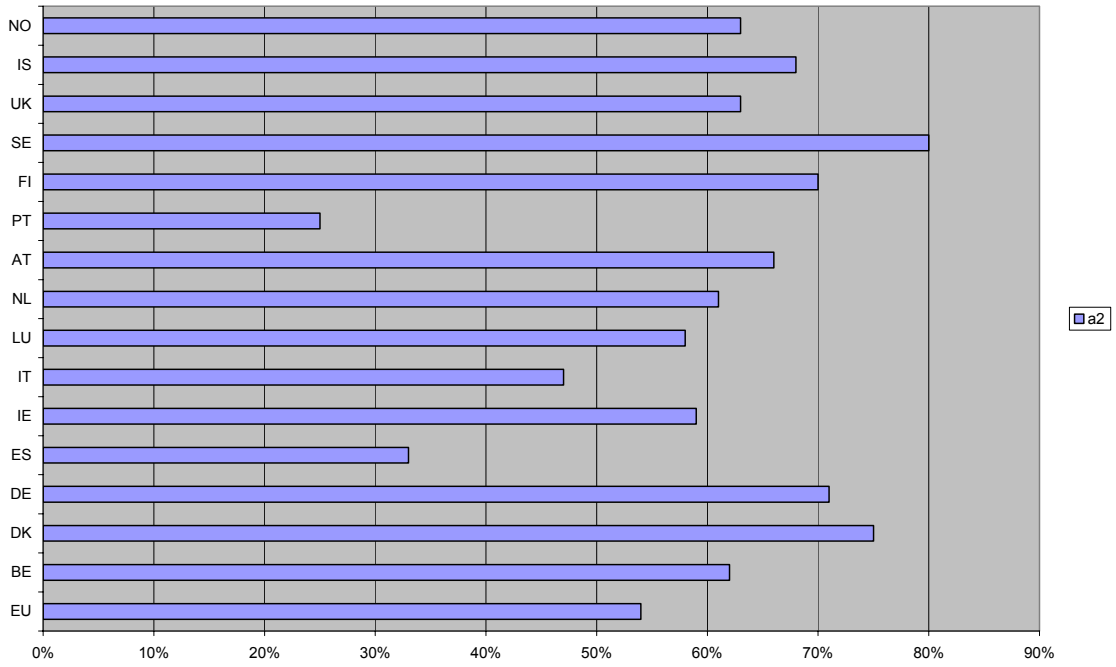
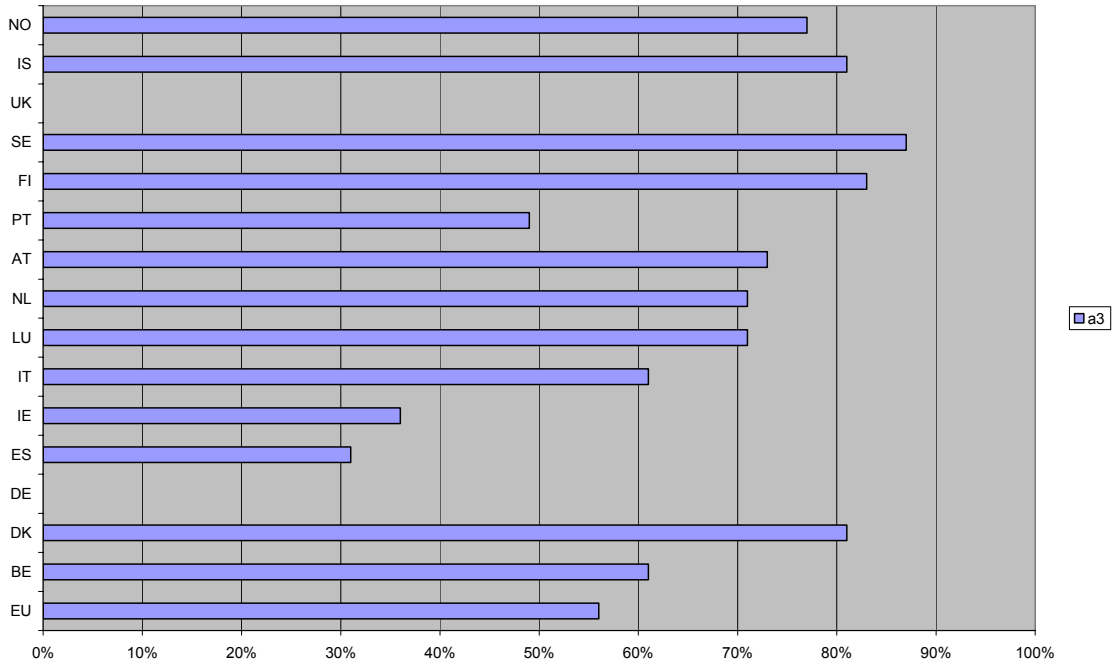
Figure 1b. Graphs for all the component indicators, 2003 data



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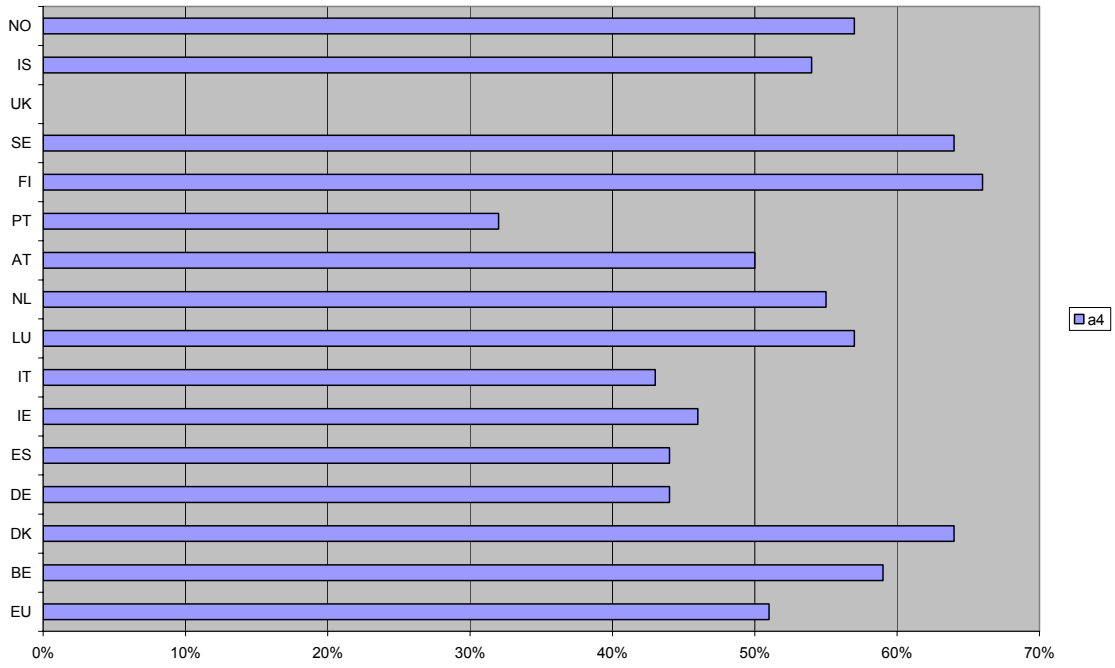
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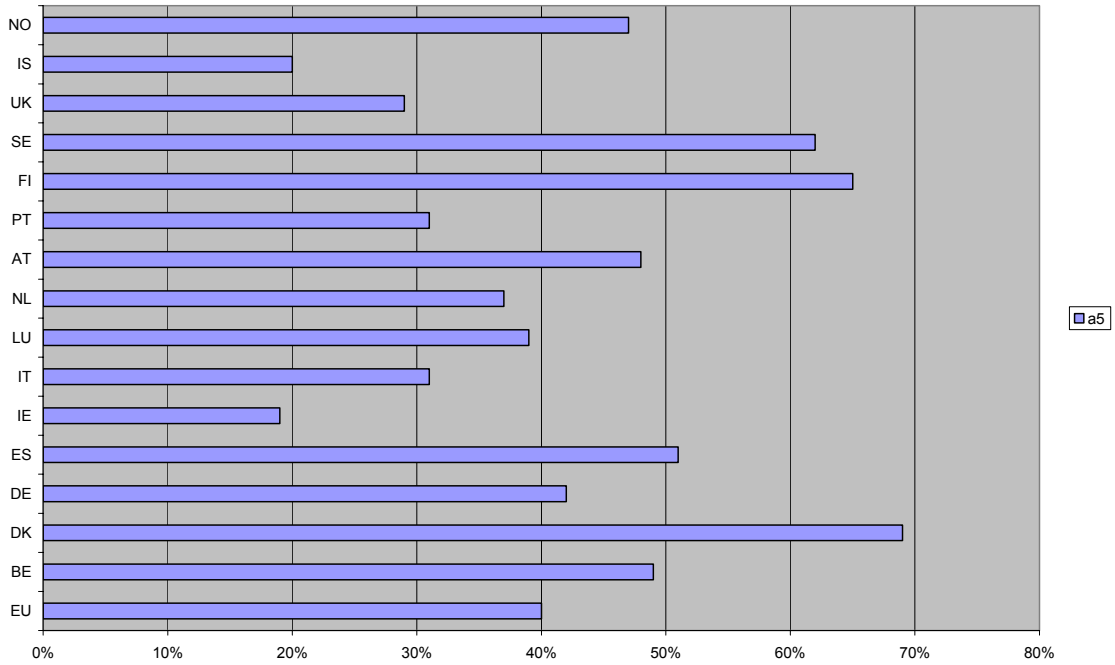
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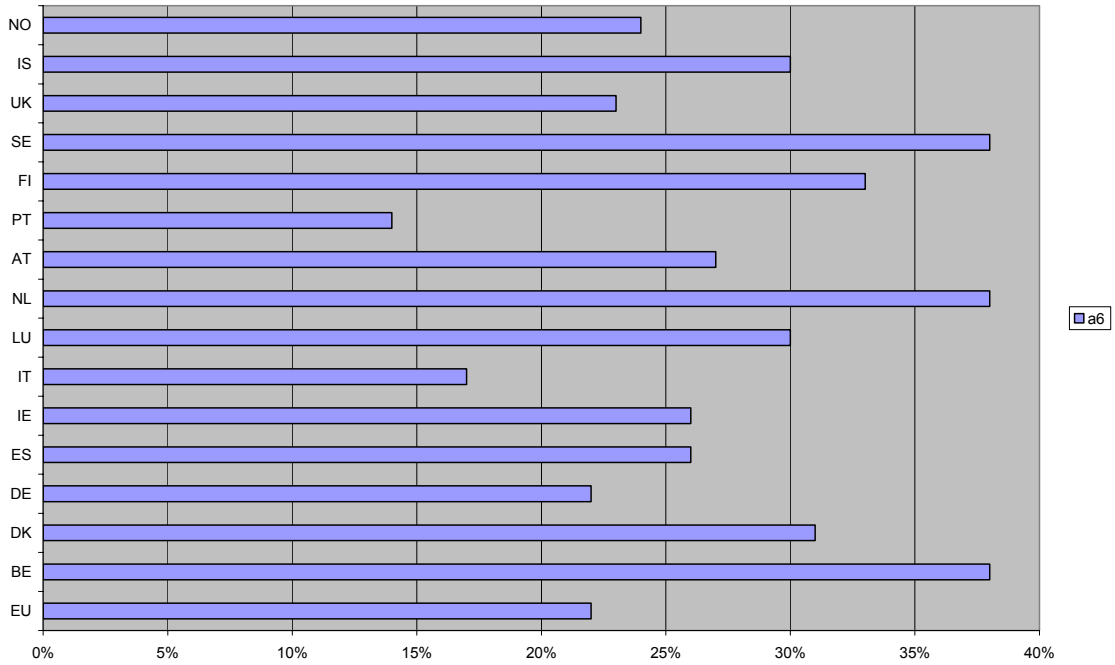
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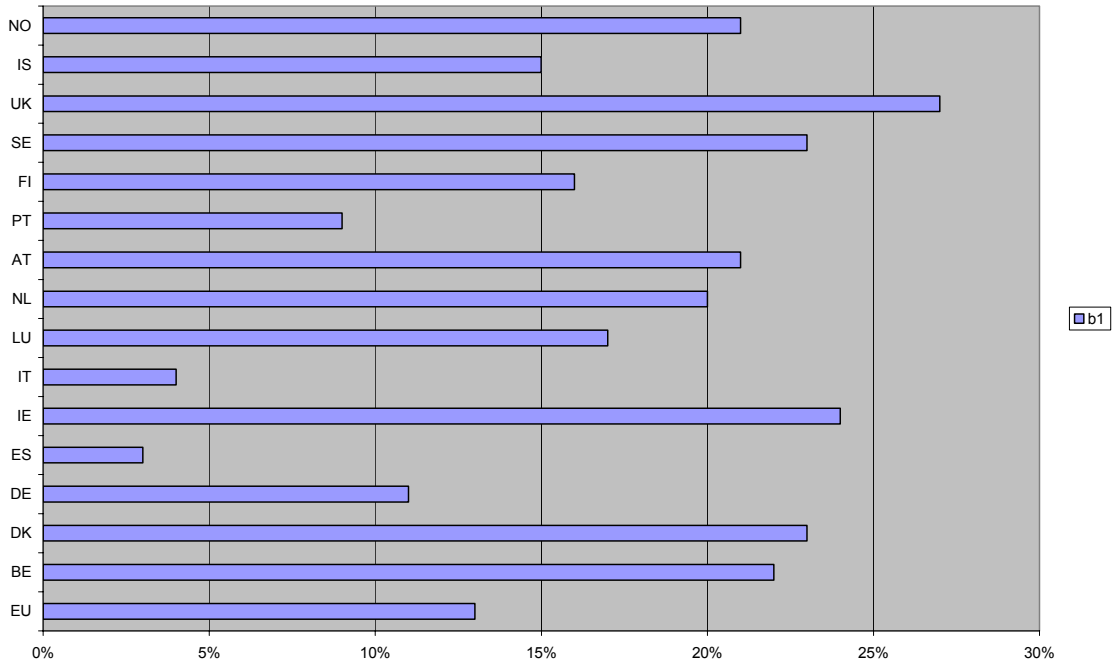
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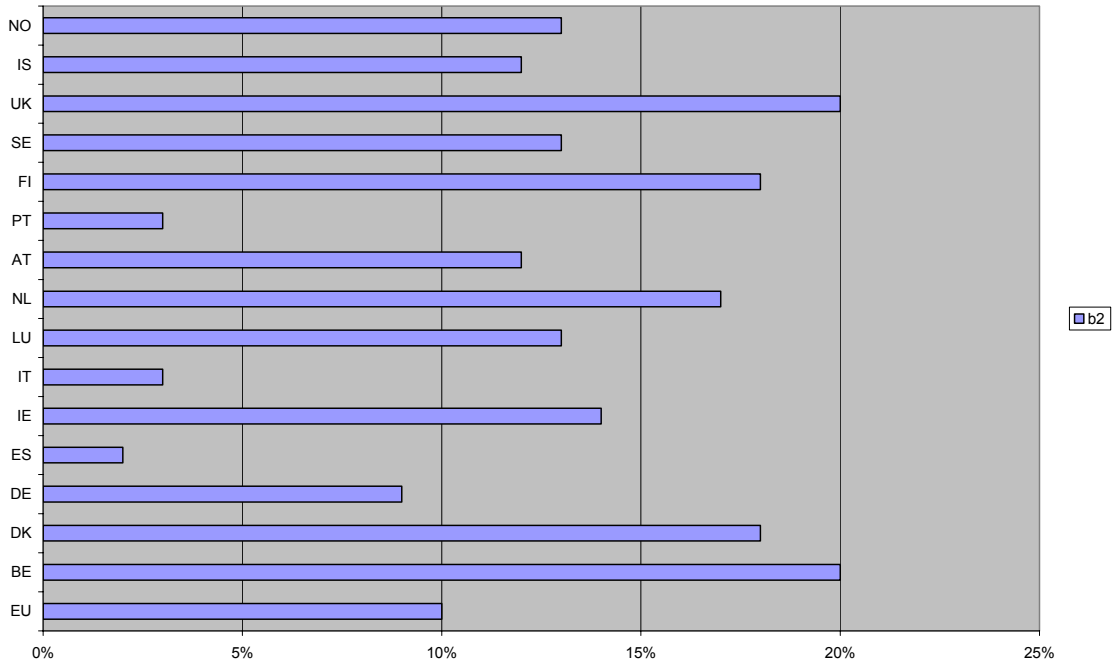
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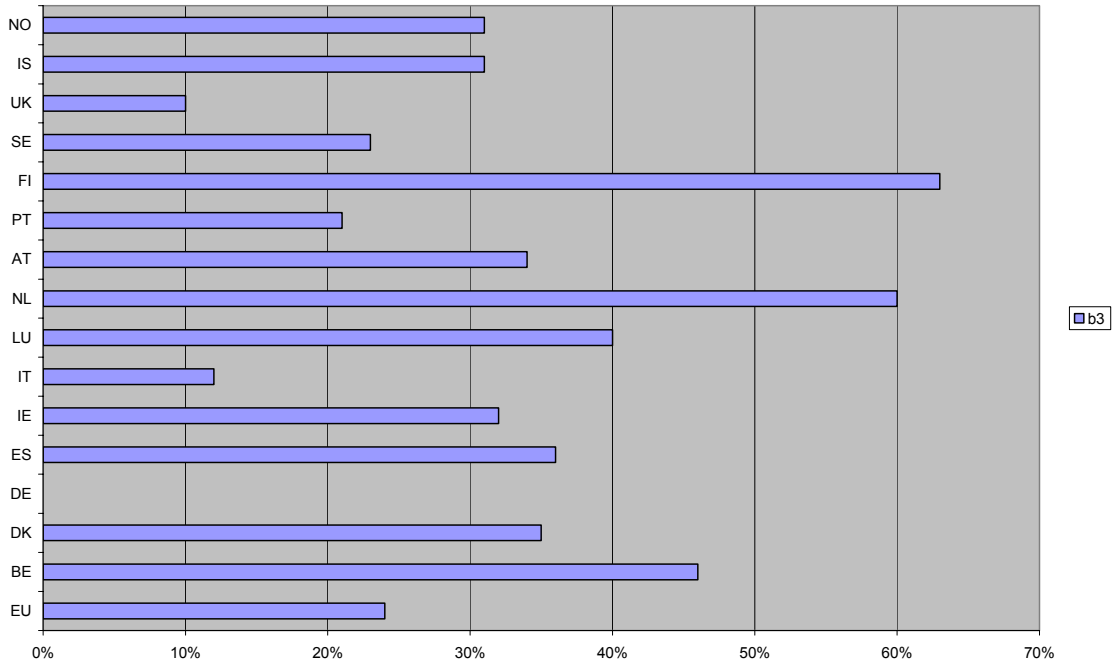
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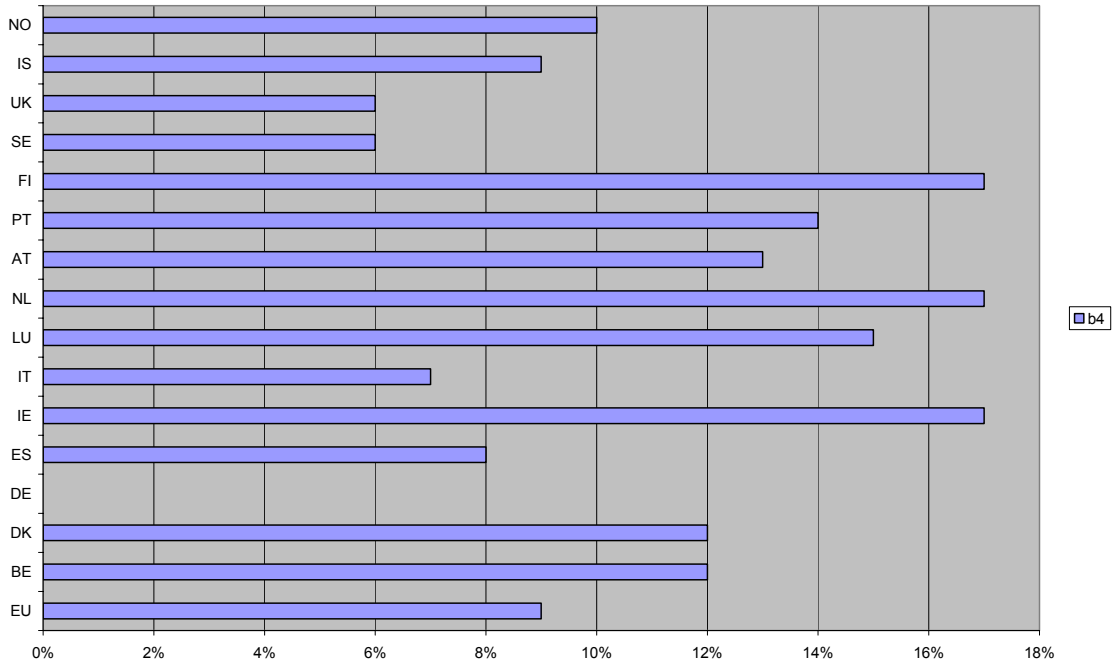
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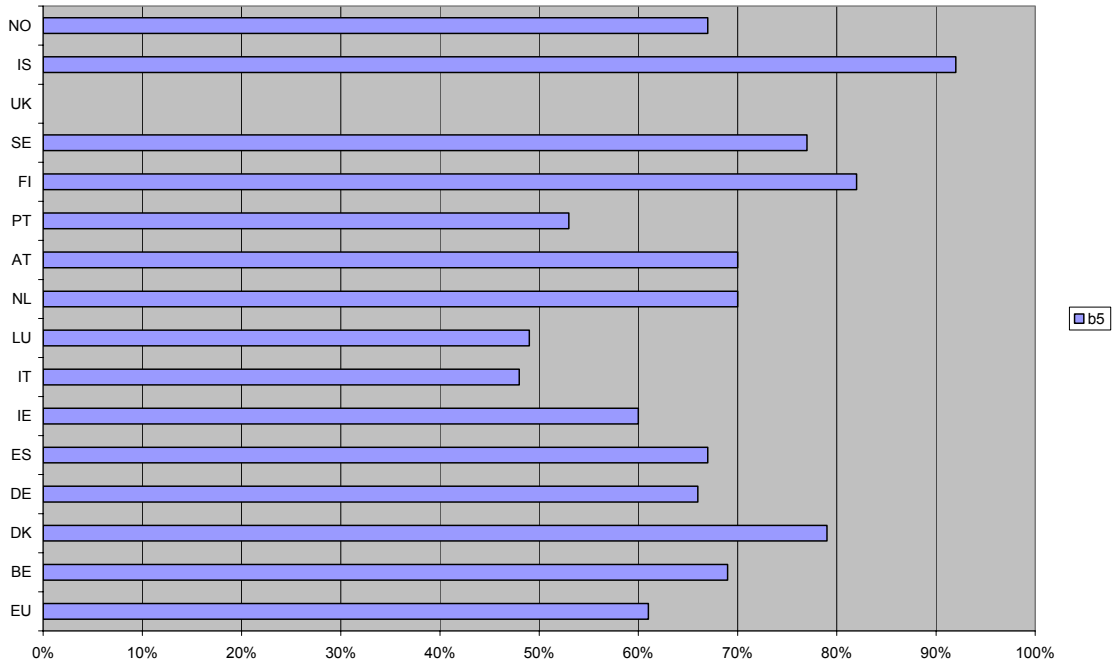
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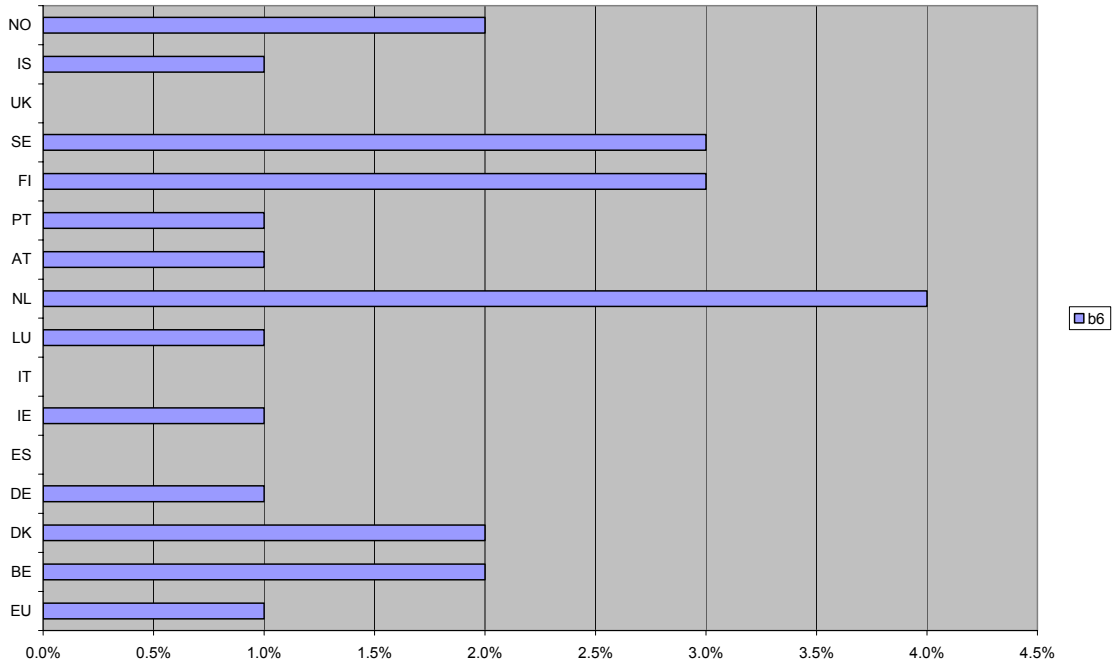


2.3. Standardisation

The basic indicators are all expressed as percentages: 11 indicators as percentages of enterprises, and one indicator (a4) as percentage of employees using computer in their normal work routine at least once a week. Therefore it was decided that there was no need for standardisation before aggregation.

2.4. Multivariate analysis

The correlation coefficients between the pairs of basic indicators for year 2003 are reported in *Table 3*.

In the group *Adoption of ICT,* the pairs (**a1, a2**) and (**a4, a6**) have a correlation coefficient higher than 0.8. High correlation is also found for the pair (**a2, a3**) and between **a4** and **a1**, **a2**, **a3**. In the group *Use of ICT*, the pairs (**b1, b2), (b3, b4),** and (**b2, b6)** are also highly correlated. A high correlation between pairs of basic indicators may indicate that they are partly showing the same aspect of the phenomenon under study. There are also some high correlations among the two groups: this indicates that the two groups partially overlap, and that the twelve basic indicators could be grouped in a different way.

The analysis of principal components would be very helpful from this point of view, but this analysis requires more data than those currently available to be meaningful.

Table 3. Correlation coefficients between indicators in 2003[5]

	a1	a2	a3	a4	a5	a6	b1	b2	b3	b4	b5
Adoption of ICT											
a2	**0.87**										
a3	0.69	**0.78**									
a4	**0.78**	**0.79**	**0.74**								
a5	0.47	0.37	0.44	0.64							
a6	0.62	0.61	0.46	**0.82**	0.43						
Use of ICT											
b1	0.33	0.67	0.48	0.64	0.12	0.53					
b2	0.49	**0.71**	0.53	**0.80**	0.23	0.66	**0.87**				
b3	0.42	0.23	0.20	0.53	0.39	0.67	0.10	0.41			
b4	0.01	-0.02	-0.09	0.04	0.01	0.23	0.14	0.27	**0.74**		
b5	**0.76**	0.62	0.55	0.62	0.35	0.58	0.38	0.50	0.38	-0.12	
b6	0.31	0.48	0.53	0.60	0.43	0.63	0.64	**0.70**	0.63	0.43	0.43

2.5. Functional form

A simple linear combination of the individual indicators has been adopted, whereby the weighted basic indicators are added up.

2.6. Weighting of basic indicators

For all indicators, the higher the percentage, the better the country performance. Three possible weighting schemes are explored.

2.6.1. EQUAL WEIGHTING

The simplest weighting scheme gives equal weights for each indicator. As there are 12 basic indicators, the weight assigned to each indicator is 1/12 = 0.083.

2.6.2. NON-EQUAL WEIGHTING USING QUALITATIVE METHODS (BUDGET ALLOCATION METHOD)

[5] Correlation coefficients R > 0.70 in bold.

Weights can be assigned to the basic indicators according to their respective different relevance in the context of phenomenon being measured. In the *"budget allocation scheme"* such weights are obtained by eliciting experts, who are assumed to have an understanding of the phenomenon targeted by the composite indicator.

For the e-business composite indicator, each expert was given a "budget" of 100 points, and was asked to allot the budget to the 12 sub-indicators according to their importance. DG Enterprise has interviewed Member States' representatives of the e-business support network (e-BSN). A detailed description of the assignment of the weights by the e-BSN experts can be found in the Annex.

The sets of weights obtained, for each core group, are listed in table 4. This table shows that experts' opinion varies to a large extent: for instance, indicator a4 (percentage of persons employed using computers in their normal week, at least once a week) ranges from weight 0 (assigned by the Finnish expert) to 15 (assigned by the Portuguese expert). Given the important correlations among indicators, it was normal finding differences as to how to distribute the budget.

Table 4. Weights obtained from Member States representatives of the e-BSN

	DK	DE	ES	FR	IE	IT	LU	NL	AT	PT	FI	SE
a1	8.3	5.0	17.9	7.5	7.5	10.0	15.0	5.0	12.5	10.0	5.0	2.5
a2	8.3	5.0	19.5	7.5	5.0	12.5	10.0	5.0	7.5	5.0	5.0	2.5
a3	8.3	10.0	0.5	7.5	7.5	5.0	2.5	2.5	5.0	5.0	0.0	7.5
a4	8.3	7.5	7.7	5.0	10.0	5.0	7.5	10.0	7.5	15.0	0.0	10.0
a5	8.3	10.0	2.5	12.5	15.0	7.5	5.0	12.5	12.5	10.0	20.0	12.5
a6	8.3	12.5	1.5	10.0	5.0	10.0	10.0	15.0	5.0	5.0	20.0	15.0
b1	8.3	5.0	8.1	7.5	7.5	10.0	12.5	12.5	5.0	10.0	5.0	7.5
b2	8.3	7.5	8.1	7.5	7.5	10.0	12.5	12.5	7.5	10.0	5.0	7.5
b3	8.3	10.0	8.1	12.5	12.5	7.5	7.5	12.5	10.0	10.0	20.0	5.0
b4	8.3	12.5	8.1	12.5	15.0	7.5	2.5	5.0	7.5	10.0	20.0	15.0
b5	8.3	10.0	10.1	5.0	5.0	5.0	7.5	2.5	12.5	5.0	0.0	2.5
b6	8.3	5.0	8.1	5.0	2.5	10.0	7.5	5.0	7.5	5.0	0.0	12.5

2.6.3. NON-EQUAL WEIGHTING USING QUANTITATIVE METHODS (FACTOR ANALYSIS)

A factor analysis (FA) has been performed on data disaggregated by firm size. Overall 48 data for each of the 12 indicators were available. Two FA have been conducted: one on the *Adoption of ICT* and one on the *Use of ICT* (to be used for the calculations). Table 5 below summarizes the obtained weights.

Table 5. Weights obtained from a factor analysis

Adoption of ICT		Use of ICT	
a1	0.18	b1	0.16
a2	0.19	b2	0.19
a3	0.17	b3	0.14
a4	0.15	b4	0.13
a5	0.15	b5	0.24
a6	0.16	b6	0.13

2.7. Calculation of the actual composite indicator

2.7.1. EQUAL WEIGHTING

Table 6, based on incomplete data, presents the results using the equal weighting scheme for the 15 EU/EFTA countries which participated in the 2003 survey on ICT usage in enterprises.

Countries show more differences in the *Adoption of ICT* than in the *use of ICT*.

Table 6: Country scores of the e-business composite indicator and ranking (using equal weights).

Ranking	C.I.	Adoption	Use
FI	0.51	0.69	0.33
DK	0.49	0.69	0.28
SE	0.48	0.71	0.24
NL	0.45	0.58	0.31
BE	0.44	0.60	0.28
IS	0.43	0.59	0.26
AT	0.42	0.59	0.25
NO	0.42	0.59	0.24
LU	0.40	0.57	0.22
DE	0.38	0.56	0.19
UK	0.37	0.54	0.20
EU	**0.36**	**0.52**	**0.20**
IE	0.35	0.45	0.25

ES	0.32	0.44	0.19
IT	0.30	0.47	0.12
PT	0.27	0.37	0.17

2.7.2. NON-EQUAL WEIGHTING USING QUALITATIVE METHODS (BUDGET ALLOCATION METHOD)

The ranking of the 15 countries according to this weighting method is given in *Table 7*. Overall, the two groups of leading countries (Finland, Denmark, Sweden, the Netherlands and Belgium) and laggard countries (Ireland, Spain, Italy and Portugal) are relatively stable, with small changes of countries within each group. The shift in ranking is limited to a maximum of three units except for Iceland, ranked 4th by the Spanish expert, yet 12th by the Finnish expert, based on their weigh assignment.

Rather than comparing the individual opinions, which vary substantially, it would be of importance to have a look at the 'consensus' of the group of experts. Such 'consensus weights' were not collected, but they can be simulated by taking the (unweighted) averages of the experts' weights for each indicator. The result of such an exercise is listed in table 7, the ranking based on such average allocation is shown as *"Panel"*.

Table 7. Ranking with the budget allocation method (experts' nationality in the column headers).

DK	DE	ES	FR	IE	IT	LU	NL	AT	PT	FI	SE	All experts
FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI
DK	DK	DK	DK	DK	DK	DK	DK	DK	DK	DK	DK	DK
SE	SE	SE	SE	SE	SE	SE	SE	SE	SE	NL	SE	SE
NL	NL	IS	NL	NL	BE	BE	BE	BE	BE	BE	BE	NL
BE	BE	BE	BE	BE	NL	NL	NL	NL	NL	SE	NL	BE
IS	IS	NL	AT	AT	AT	IS	AT	IS	NO	AT	AT	AT
AT	AT	AT	NO	NO	IS	AT	NO	AT	AT	LU	NO	NO
NO	NO	NO	LU	LU	NO	NO	LU	NO	IS	NO	LU	IS
LU	LU	DE	IS	IS	LU	LU	IS	LU	LU	ES	IS	LU
DE	DE	LU	DE	DE	DE	DE	IE	DE	DE	IE	UK	DE
UK	UK	IE	**EU**	**EU**	UK	IE	UK	**EU**	UK	DE	DE	**EU**
EU	**EU**	UK	UK	UK	IE	UK	DE	IE	**EU**	IS	**EU**	UK

IE	IE	**EU**	IE	IE	**EU**	**EU**	**EU**	UK	IE	**EU**	IE	IE
ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	UK	ES	ES
IT	IT	IT	IT	IT	IT	IT	IT	IT	IT	PT	IT	IT
PT	PT	PT	PT	PT	PT	PT	PT	PT	PT	IT	PT	PT

2.7.3. NON-EQUAL WEIGHTING USING QUANTITATIVE METHODS (FACTOR ANALYSIS)

Table 8 gives the scores on the overall composite indicator and the two sub-indicators on adoption and use as well as the ranking, obtained by applying the Factor Analysis (FA) weights.

Table 8: Country scores of the e-business composite indicator and ranking (based on FA weights).

Ranking	C.I.	Adoption	Use
FI	0.53	0.70	0.37
DK	0.51	0.70	0.33
SE	0.50	0.72	0.29
NL	0.47	0.59	0.34
BE	0.46	0.61	0.32
IS	0.46	0.60	0.32
AT	0.44	0.60	0.29
NO	0.44	0.60	0.28
LU	0.41	0.57	0.25
DE	0.40	0.58	0.23
UK	0.39	0.55	0.23
EU	**0.38**	**0.52**	**0.23**
IE	0.37	0.46	0.28
ES	0.34	0.44	0.23
IT	0.31	0.48	0.15
PT	0.28	0.37	0.20

2.7.4. COMPARISON OF THE COUNTRIES' RANKING IN THE DIFFERENT WEIGHTING SCHEMES

When comparing tables 6, 7 (ranking by the 'virtual' panel) and 8, we see that the ranking is relatively stable: Finland and Denmark are the leading countries, followed by the group of the Netherlands, Sweden and Belgium, while Ireland, Spain, Italy and Portugal are the lagging countries. The rankings of countries using equal weights are equal to those using weights provided by the factor analysis. With the e-BSN "panel", the country ranking remains unchanged but for UK (which moves from just above EU-average to just below it) and for Iceland (which overcomes Austria and Norway).

2.8. Tests of robustness

2.8.1. LEAVE-ONE-OUT ROBUSTNESS

The first test of robustness has been performed with respect to the exclusion/inclusion of one basic indicator. The test consists in observing, via simulation studies, how much the country ranking would be affected by excluding one of the basic indicators. The objective of this exercise is to identify situations where the omission of one indicator shifts the ranking of each country: this situation would indicate that the composite indicator is sensitive to one of its basic components. This would require additional investigation, because missing values assume then high importance.

Tables 9 and 10, based on the equal weighting scheme, show that the e-readiness composite indicator is robust to the omission of one basic indicator, i.e. such omission would result in a modest change of rankings. The group of leading countries (whose e-readiness is well above the EU-15 average) sees Finland Denmark and Sweden stably at the top. The Netherlands, Belgium and Iceland share the third, fourth and fifth position. The simulation affects the rank of the countries with only one/two units around the "baseline" value (i.e. the country rank when all indicators are considered). We see that Iceland loses three places when indicator b5 is omitted, due to the fact that Iceland has by far the highest score on this indicator.

Table 9. Country rankings for the e-readiness composite indicator when one indicator is omitted (equal weighting scheme).

baseline	a1=0	a2=0	a3=0	a4=0	a5=0	a6=0	b1=0	b2=0	b3=0	b4=0	b5=0	b6=0
FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI
DK	DK	DK	DK	DK	DK	DK	DK	DK	DK	DK	DK	DK
SE	SE	SE	SE	SE	SE	SE	SE	SE	SE	SE	SE	SE
NL	NL	NL	BE	NL	NL	NL	NL	NL	BE	NL	NL	NL
BE	BE	BE	NL	BE	IS	BE	BE	BE	IS	BE	BE	BE
IS	AT	IS	AT	IS	BE	IS	IS	IS	NL	IS	AT	IS
AT	NO	NO	IS	AT	AT	NO	AT	AT	AT	AT	NO	AT
NO	IS	AT	NO	NO	NO	AT	NO	NO	NO	NO	LU	NO
LU	LU	LU	LU	LU	LU	LU	LU	LU	LU	LU	IS	LU
DE	UK	DE	DE	DE	UK	DE	DE	DE	UK	DE	UK	DE
UK	DE	UK	IE	UK	DE	UK	**EU**	UK	DE	UK	DE	UK
EU	**EU**	**EU**	**EU**	**EU**	IE	**EU**	UK	**EU**	**EU**	**EU**	**EU**	**EU**

IE	IE	IE	UK	IE	**EU**	IE	IE	IE	IE	IE	IE	IE
ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES
IT	IT	IT	IT	IT	IT	IT	IT	IT	IT	IT	IT	IT
PT	PT	PT	PT	PT	PT	PT	PT	PT	PT	PT	PT	PT

Table 10. Country rankings for the e-readiness composite indicator when one indicator is omitted (weighting scheme based on factor analysis outcome).

baseline	a1=0	a2=0	a3=0	a4=0	a5=0	a6=0	b1=0	b2=0	b3=0	b4=0	b5=0	b6=0
FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI
DK	DK	DK	DK	DK	DK	DK	DK	DK	DK	DK	DK	DK
SE	SE	SE	SE	SE	SE	SE	SE	SE	SE	SE	SE	SE
NL	NL	IS	BE	NL	IS	IS	NL	NL	IS	IS	NL	NL
BE	BE	NO	NL	IS	NL	BE	IS	IS	BE	BE	BE	BE
IS	IS	BE	IS	BE	BE	NL	BE	BE	NL	NL	AT	IS
AT	AT	NL	AT	AT	AT	AT	AT	AT	AT	AT	NO	AT
NO	NO	AT	NO	NO	NO	NO	NO	NO	NO	NO	LU	NO
LU	LU	LU	LU	DE	LU	DE	LU	LU	DE	LU	IS	LU
DE	UK	DE	DE	LU	DE	LU	DE	DE	UK	DE	UK	DE
UK	DE	UK	IE	UK	UK	UK	**EU**	UK	LU	UK	DE	UK
EU	**EU**	**EU**	**EU**	**EU**	IE	**EU**	UK	**EU**	**EU**	**EU**	IE	**EU**
IE	IE	IT	UK	IE	**EU**	IE	IE	IE	IE	IE	**EU**	IE
ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES	ES
IT	IT	IE	IT	IT	IT	IT	IT	IT	IT	IT	IT	IT
PT	PT	PT	PT	PT	PT	PT	PT	PT	PT	PT	PT	PT

2.8.2. ROBUSTNESS OF THE WEIGHTING SCHEMES

The second test of robustness has been performed with respect to both the weighting scheme and the uncertainty due to imputation of missing values for Germany (indicators **a3, b3, b4**) and for UK (indicators **a3, a4, b5, b6**). Markov Chain Monte Carlo has been applied to impute missing values, obtaining 20 different imputations for each missing value. Further, Monte Carlo has been used to sample from the distributions of the imputed values. A sample of 1000 points has been generated from a multi-normal distribution with mean and variance estimated from the set of

20 imputations. Each sample point is associated to the weights provided by one e-BSN expert, selected at random, and the e-business readiness is calculated.

Figure 2 displays the box-plots of e-business readiness for each country. The box has lines at the lower quartile, median, and upper quartile values. The whisker lines extending from each end of the box show the extent of the rest of the data. The outliers (below 1 and above 99 percentiles) are indicated with plus signs.

The graphs should be read "horizontally": sets of box plots partially overlapping indicate situations when the ranking of the corresponding countries can interchange, so showing a lack of robustness.

Figure 2. Composite indicator of e-business readiness in 2003 with box plots (results of the simulation on national experts' weighting).

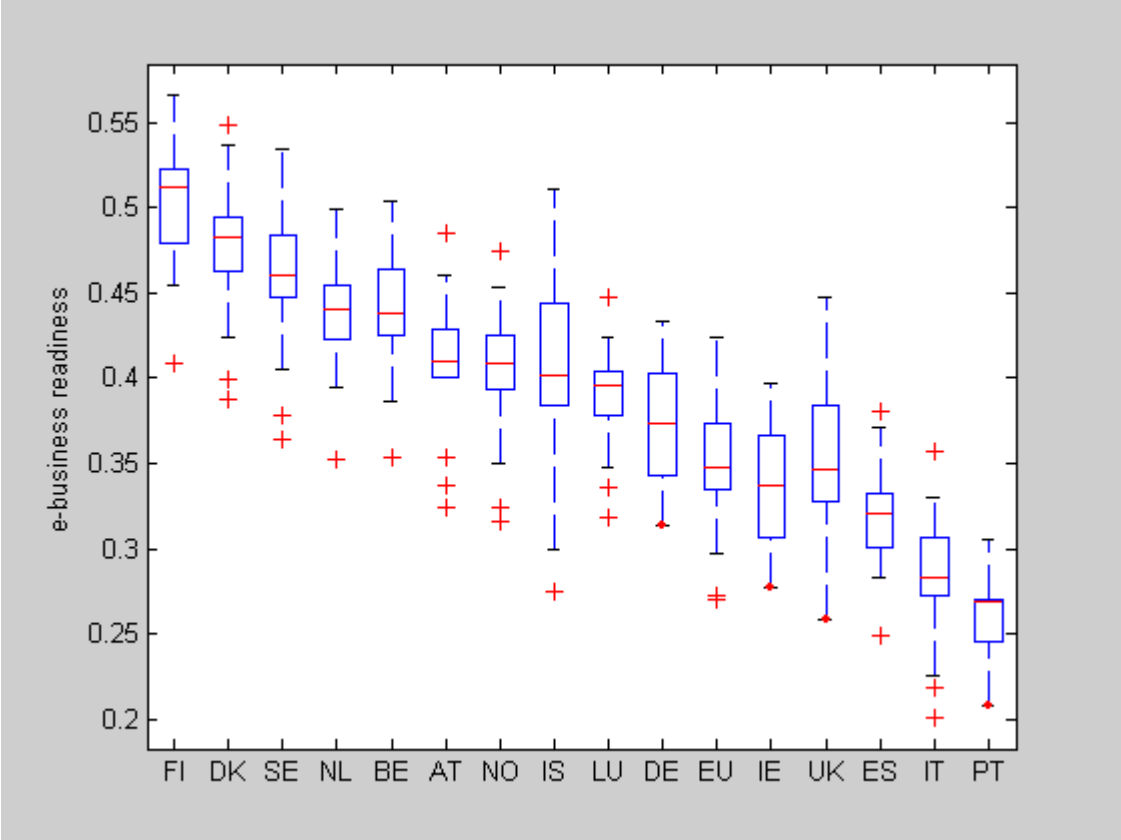
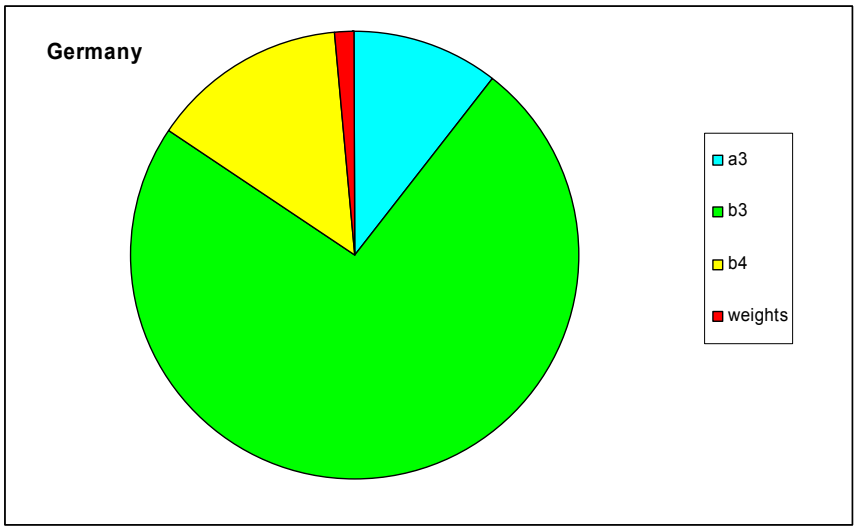


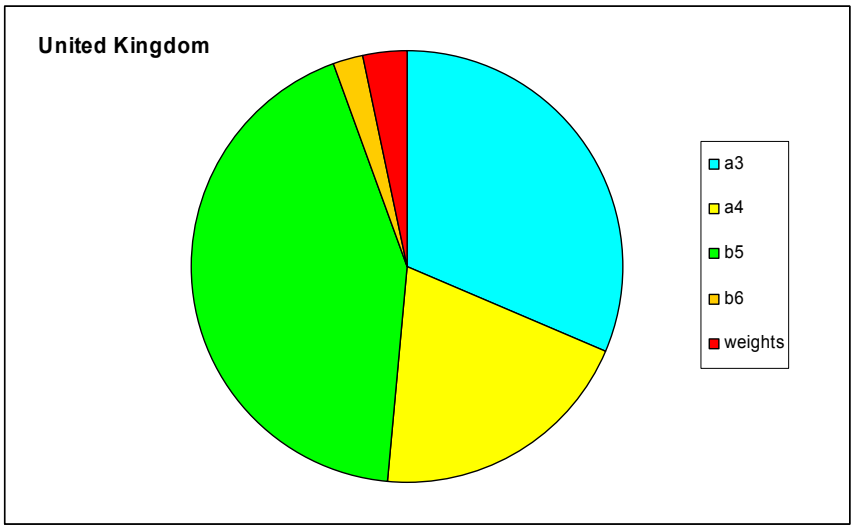
Figure 2 shows that the heterogeneity in the weights provided by the e-BSN experts results in an overlap of the uncertainty bars between countries (sometimes total

overlap, such as in the cases of Luxembourg with Germany), which represent the uncertainty affecting the e-business readiness.

Figure 3 shows the contribution of the uncertain factors (imputed sub-indicators and weights) to the total variation of the e-business readiness for Germany and UK. The sensitivity analysis has been carried out using variance-based methods explained in Saltelli et al., 2004. The Figure indicates that the imputation of indicator **b3** for Germany, and of indicators **b5** and **a3** for UK, affect largely the e-business readiness. Availability of these data is crucial to determine the exact ranking of these two countries.

Figure 3. Contribution of the uncertain factors (imputed sub-indicators and weights) to the total variation of the e-business readiness for Germany and UK





2.9. Final assessment and dissemination strategy

Figure 4 displays a plot of 'Adoption' versus 'Use' of ICT values for the 15 EU/EFTA countries based on the equal weighting scheme (see *Table 6)*. A high score in *Adoption of ICT* is generally associated with a high score in the *Use of ICT.*

Figure 4: Adoption of ICT vs. Use of ICT (equal weighting scheme)

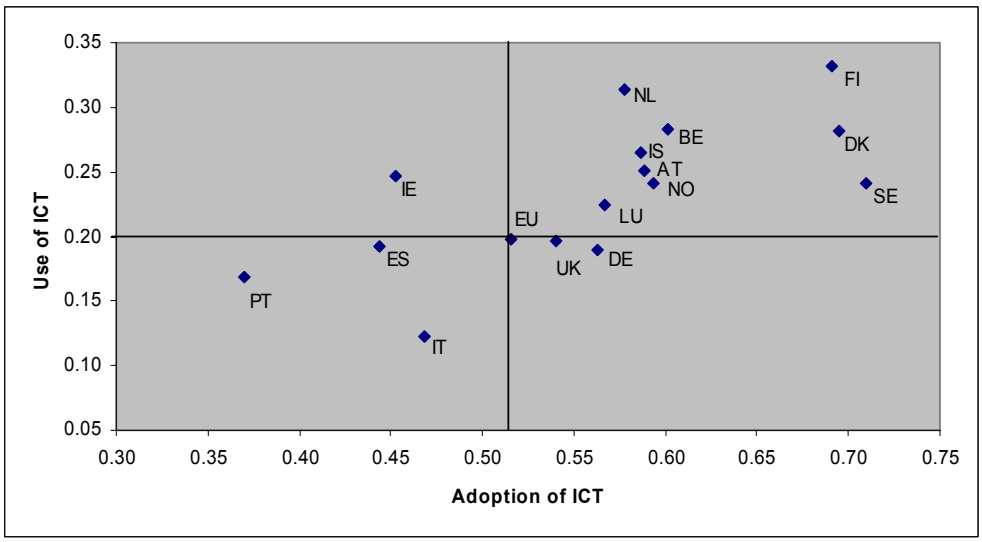
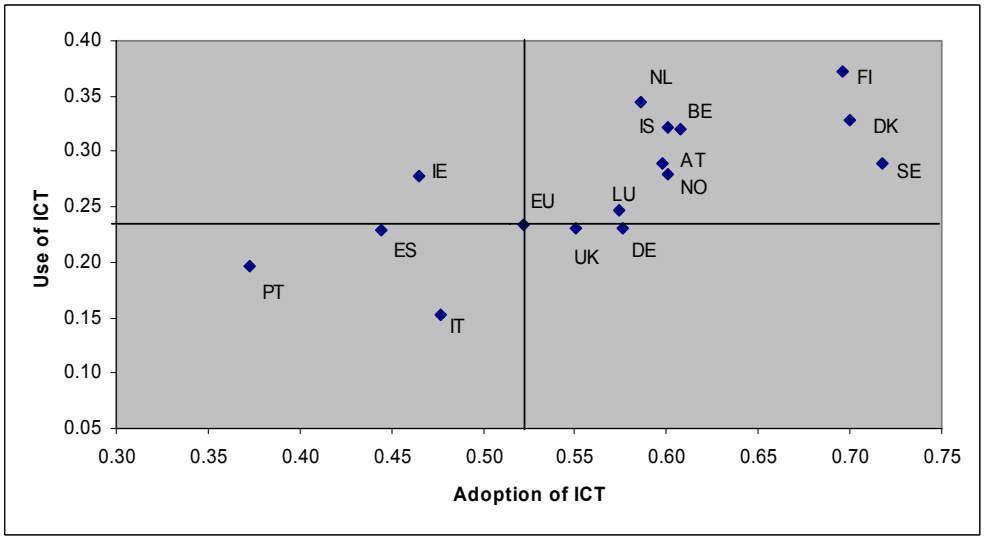


Figure 5 displays an analogue plot using the weights obtained in a factor analysis (see *table 5*). As we already concluded earlier, the results are similar to those in Figure 4 based on the equal weighting scheme.

Figure 5: Adoption of ICT vs. Use of ICT (factor analysis)

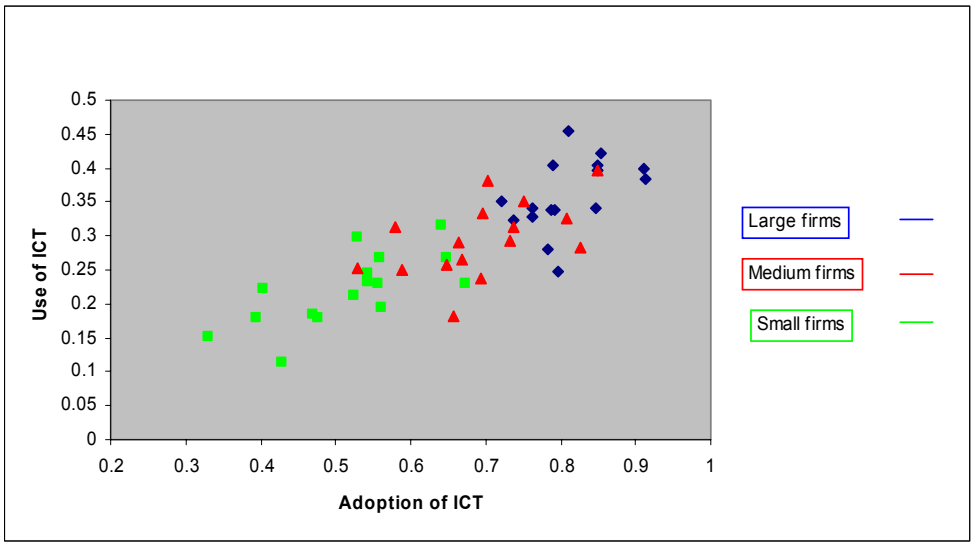


The basic indicators on Adoption and Use of ICT were also broken down by firm size. Three categories of firms have been considered: large (with more than 250 employees), medium (50 to 249 employees), and small (10 to 49 employees).[6]

[6] Firms with less than 5 employees have not been considered due to the unavailability of data for all countries considered.

Figure 6 presents the Adoption and Use of ICT depending upon firm size (using the equal weighting scheme). As expected, large firms tend to adopt and use new communication technologies more than medium and small firms. This graph shows that the values of the composite indicator are depending on the "size structure of firms" in the country.

Figure 6: Adoption and Use of ICT, breakdown by firm dimension (number of employees)



3. *Concluding remarks and proposal for future activities*

The e-business readiness indicator presented in the previous section might be used for analysing the countries' performance in ICT. Results of the exercise indicate that the participating countries are forming three categories with regard to e-readiness: the more advanced countries, the in-between ones, and those needing further impetus for a widespread adoption and use of ICT. However, we consider that the components of the e-business readiness need somehow to be revised, as some important elements of 'Access' and 'Use' of ICT are currently missing (e.g., *e-skills*, *ICT influence on enterprise organisation and management, internet connection costs, etc.*). The critical revision of these components is recommended to achiever a more effective index.

References

Saltelli, A., S. Tarantola, F. Campolongo and M. Ratto (2004) Sensitivity Analysis in Practice: A Guide to Assessing Scientific Models, Wiley.

Annex

Note on the process of establishing by the e-Business Support Network (eBSN) the component weight values for the eEurope 2005 Action Plan Benchmarking Indicator "H", e-business readiness index (DG ENTR)

EUROPEAN COMMISSION
ENTERPRISE DIRECTORATE-GENERAL

Services, tourism, new technologies and design industries
E-business ; ICT industries and services

Brussels, 1 March 2004
ENTR.D.4 D(2004)

NOTE ON THE PROCESS OF ESTABLISHING BY THE E-BUSINESS SUPPORT NETWORK (EBSN) THE COMPONENT WEIGHT VALUES FOR THE EEUROPE 2005 ACTION PLAN BENCHMARKING INDICATOR "H", E-BUSINESS READINESS INDEX

Abstract

This note records the process establishing the component weight values for the eEurope 2005 Action Plan Benchmarking Indicator "H", e-business readiness index. Firstly, the subject is introduced. Secondly, the political mandate and role of the e-Business Support Network (eBSN) is described. Thirdly, the voting process is described. Finally, the record of the obtained weights is described.

e-Europe 2005 e-business readiness index

In August 2002 Directorate – General Enterprise, represented first proposals of the e-business readiness index initiating the process, which culminated in the inclusion of the e-readiness index pilot exercise into the e-Europe 2005 Action Plan Benchmarking indicators.[7]

The Council Resolution of 28 January 2003[8] on the implementation of the eEurope 2005 Action Plan (5197/03) requests the Commission to carry out a pilot study to calculate a composite indicator on e-business readiness, using data from the enterprise survey conducted in 2003. The components of the e-business readiness composite indicator are listed in the Annex 2.H of that Council Resolution. There are a total of 12 components in this indicator.

e-Europe 2005 is a political program with clear objects and targets. Consequently, DG Enterprise has further promoted the use of the eBSN to provide the weights for the sub-components, capturing the political priority setting of the Member States.

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7 Büscher R.; Karageorgos G.; Noël F (DG ENTR/D-4); Koszerek D.; Deiss R.; David C. (DG ESTAT/ D5) Towards a 'European enterprises e-readiness indicator: Concept and first preliminary results, August 2002.

8 www.eseeurope.undp.ba/sadrzaj/RelatedDocuments/sadrzaj/terms/Indicators%20Resolution.pdf

The eEurope Action Plan, initially launched for 3 years in 2000 as a follow-up to the Lisbon agenda and now continued as eEurope 2005, is a program with clear objectives and targets addressed to both the Commission and the Member States. Following the Lisbon Council, the 'open method of co-ordination' has been established among EU Member States. This process involves not only the agreement on common policy guidelines, but also the setting of quantitative targets and indicators to benchmark performance and to help the identification of best practice within a peer-review context. It is in this context that DG Enterprise has used the European eBusiness Support Network (eBSN) to assist in suggesting the weights for the sub-components that comprise the e-business index, thereby reflecting the political priorities of Member states in this respect.

The European e-Business Support Network (eBSN)

1.1 The political mandate of the eBSN

The eBSN was launched in 2003 as a response to:

the Industry Council's conclusions of June 6, 2002 (*inviting the Member States and the Commission to "intensify dialogue, exchange regularly experience, identify specific goals for e-business policies and to share best practices*"), and

the eEurope 2005 Action Plan (adopted by the Commission on 28 May 2002 and endorsed by the European Summit in Seville on 21 June 2002) foreseeing *the establishment of "an European e-business support network, federating existing European, national and regional players in this field with a view to strengthening and co-ordinating actions in support of SMEs in the field of e-business*".

Following the Commissions communication on "Adapting e-business policies in a changing environment" , the Competitiveness Council of 13 May 2003 welcomed the Commission's initiative and invited Member States and Acceding Countries "*to actively engage in the European e-Business Support Network for SMEs*".

1.2 The creation and role of the eBSN

The European Commission (Directorate-General Enterprise) has coordinated the creation of the eBSN. All participating countries' governments have formally nominated their representatives to the eBSN Steering Group.

The eBSN builds upon the results of the benchmarking initiative on national and regional policies in support of e-business for SMEs that was conducted in 2002, aiming to improve co-operation among existing e-business policy initiatives in Europe and to better use synergies between them. The eBSN is open to the voluntary participation of all relevant policy initiatives in support of e-business for SMEs in the Member States, the Acceding and Candidate

Countries and the EEA Countries. An eBSN portal[9] is being established to facilitate the exchange of information and the communication with and among the eBSN members.

To facilitate the diffusion of best practise and to encourage cross-border co-operation among eBSN members, thematic workshops are regularly organised. In 2003, eBSN workshops were held in Athens, Brussels and Paris. The next workshops are planned for Budapest (25 February 2004) and Barcelona (June 2004).[10]

A future priority of the eBSN is to extend its activities to the Acceding and Candidate Countries. To this end, a call for proposal will be launched in order to stimulate the co-operation between eBSN members with different e-business policy challenges in the same fields, reflecting different stages of e-maturity and building upon the most successful strategies in Europe. This campaign shall result in a series of targeted events, notably in the Acceding and Candidate Countries, addressing the objectives as described in the Commission's communication on "Adapting e-business policies in a changing environment".

The component weight voting process

One mandatory part of a composite indicator is the weighting of the effects (contributions) of the sub-components towards the composite indicator. If this process cannot be based on the empirically tested causal model, one, which also can be used to capture the political desirability and importance of sub-components, is the budget allocation method. As The Joint Research Centre has described in the report on the composite indicators[11], the budget allocation method has been successfully used for the development of many international and EU – level indicators.

The budget allocation method works by a process, where the members of the voting body each receive a number of points, which they must allocate between their choices. Analogy is the allocation of funds to the state's budget lines.

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[9] http://europa.eu.int/comm/enterprise/ict/policy/e-bus-snfsme.htm

[10] http://europa.eu.int/comm/enterprise/ict/policy/e-bus-snfsme/ebsn-events.htm

[11] European Commission, Joint Research Centre: "State-of-the-Art Report on Current Methodologies and Practices for Composite Indicator Development", 2002, (EUR 20408 EN), 72 pp.

1.3 Testing

The eBSN Steering Group conducted a pilot voting exercise in the Paris meeting (25-26 October 2003). The results of this were submitted to the JRC, which has been since the beginning of the year 2003, developed and tested the e-readiness index. After the JRC testing the results were positive, and a full scale voting took place in November – December 2003.

1.4 Official voting process

Bodies qualified to vote: The Official Representatives of the current Member States (MS) of the European Union, as nominated by the Member States, to the Steering Group of the e-Business Support Network. The voting bodies are listed in the annexes.

Voting method: Written procedure was used. Each MS representative of the eBSN was given 100 points to be distributed among the first 6 components (a1…a6) and again second set of 100 points among the second set of 6 components (b1…b6) of the e-business readiness index components.

Vote variance (1): The voters were not provided with the year 2003 data for the components, at the moment of the voting. This was done, as the data was not available from Eurostat. However, all Member States which did have their "ICT usage of enterprises 2003"– survey completed, did know their own data.

Vote variance (2): The voters were not provided with information on the vote results already accumulated, at the moment of the voting. This was done, to reveal the true differences in the opinions and to reduce the "opinion leader" – effect. This approach was selected, as the voters principally represented their MS, to reveal the priorities.

1.5 Results

Table 1. *Weights obtained from Member States representatives of the e-BSN.*

	A	D	DK	FIN	F	IRL
a1	25	10	16.66	10	15	15
a2	15	10	16.66	10	15	10
a3	10	20	16.66	0	15	15
a4	15	15	16.66	0	10	20
a5	25	20	16.66	40	25	30
a6	10	25	16.66	40	20	10
b1	10	10	16.66	10	15	15
b2	15	15	16.66	10	15	15
b3	20	20	16.66	40	25	25
b4	15	25	16.66	40	25	30
b5	25	20	16.66	0	10	10
b6	15	10	16.66	0	10	5

	I	L	NL	P	S	E
a1	20	30	10	20	5	35
a2	25	20	10	10	5	38
a3	10	5	5	10	15	1
a4	10	15	20	30	20	15
a5	15	10	25	20	25	5
a6	20	20	30	10	30	3
b1	20	25	25	20	15	16
b2	20	25	25	20	15	16
b3	15	15	25	20	10	16
b4	15	5	10	20	30	16
b5	10	15	5	10	5	20
b6	20	15	10	10	25	16

Total of 12 MS, representing over 81 % of the GDP and 80 % of the MS of the EU-15, provided their weight votes in the defined time frame.

1.6 List of the Member State – representatives of the eBSN providing their votes to the e-business readiness index weights. December 2003.

Name	Organisation/address	Country
Mr Werner Dajani	**Bundesministerium für Wirtschaft und Arbeit – Abteilung**	**Austria**
Troels Ranis Special Advisor	**Ministry of Science, Technology and Innovation**	**Denmark**
Mr. Peter Bleeck	**Bundesministerium für Wirtschaft und Technologie**	**Germany**
Mr. Antti Eskola Commercial Counsellor	**Ministry of Trade and Industry**	**Finland**
Mme Anne Huguenin	**Ministère Economie Finances Industrie**	**France**
Anne Forde	**Dept. of Enterprise Trade and Employment**	**Ireland**
Mr. Umberto Guidoni	**Ministero delle Attività Produttive**	**Italy**
Mr.Charles-Henri Di Maria	**Centre de recherche public Henri Tudor Economie de la connaissance et management de l'innovation**	**Luxembourg**
Mr.Peter Koudstaal	**Syntens Rotterdam**	**The Netherlands**
Eng. Ana Maria Moreira	**Direcção Geral da Indústria**	**Portugal**
Mr. Jesús Galván Ruiz		**Spain**
Mr. Mikael von Otter	**Swedish Alliance for Electronic Commerce**	**Sweden**